



INDUSTRIAL MATERIALS RECYCLING

TOOLS & RESOURCES

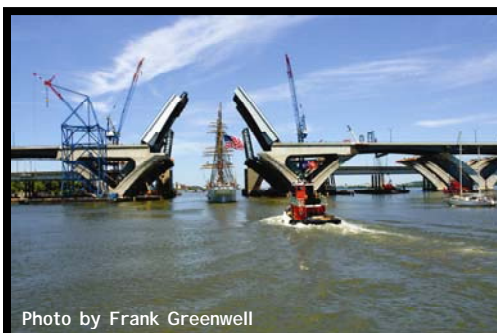


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EPA'S RESOURCE CONSERVATION CHALLENGE

Increasing the recycling and beneficial use of industrial materials

The EPA's Resource Conservation Challenge (RCC) is a national effort to conserve natural resources and energy and reduce greenhouse gas (GHG) emissions by managing materials more efficiently. Increasing the recycling and beneficial use of industrial materials is one of four national priority areas of the RCC. Each year, industry generates well over 500 million tons of materials that would otherwise be waste. Thus, the recycling of these materials represents a significant opportunity along with significant challenges. EPA formed the Industrial Materials Recycling (IMR) Program to develop and implement strategies to achieve the RCC goals for industrial materials recycling.

This document is an update to the March 2008 *Industrial Materials Recycling Tools and Resources* which compiles fact sheets, guidance and technical documents, regulations, specifications/standards, sample contract language, websites, and other references pertinent to the reuse and recycling of industrial materials. It represents a sampling of information on industrial materials recycling in the public domain. We hope you find it useful. If you are aware of additional resources that can be added to this collection, please address your comments to: EPA's Industrial Materials Recycling Program, U.S. EPA's Office of Solid Waste (MC 5306P), Washington, DC, 20460.



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TABLE OF ACRONYMS

AASHTO	American Association of State Highway and Transportation Officials
ACAA	American Coal Ash Association
ACI	American Concrete Institute
ACPA	American Concrete Paving Association
AFS	American Foundry Society
AGC	Associated General Contractors of America
ARRA	Asphalt Recycling and Reclaiming Association
ARS	Agricultural Research Service
ASTM	American Society for Testing and Materials
ASTSWMO	Association of State and Territorial Solid Waste Management Officials
BEES	Building for Environmental and Economic Sustainability
BenReMod	Beneficial Reuse Model
BUD	Beneficial Use Determination
BUIC	Beneficial Use Information Center
C&D	Construction and Demolition
C ² P ²	Coal Combustion Products Partnership
CBRC	Combustion Byproducts Recycling Consortium
CCA	Chromated Copper Arsenate
CCP	Coal Combustion Products
CICA	Construction Industry Compliance Assistance Center
CIR	Cold In-Place Recycling
CIWMB	California Integrated Waste Management Board
CMRA	Construction Materials Recycling Association
CPG	Comprehensive Procurement Guidelines
CUB	Coal Utilization Byproducts
DOE	U.S. Department of Energy
DOT	Department of Transportation
EERC	Energy and Environmental Research Center
EPA	U.S. Environmental Protection Agency
EPP	Environmentally Preferable Purchasing
ERP	Energy Resources Program
FGD	Flue Gas Desulfurization
FHWA	Federal Highway Administration
FIRST	Foundry Industry Recycling Starts Today
GHG	Greenhouse Gas
GSA	U.S. General Service Administration
HBN	Healthy Building Network
IMR	Industrial Materials Recycling
InDOT	Indiana Department of Transportation
IRC	Industrial Resources Council
IWEM	Industrial Waste Evaluation Model
JTR	Jobs Through Recycling
LEED	Leadership in Energy and Environmental Design
MOU	Memorandum of Understanding

NCASI	National Council for Air and Stream Improvement Inc.
NDA	National Demolition Association
NEWMOA	Northeast Waste Management Officials' Association
NRC	National Recycling Coalition
NRMCA	National Ready Mixed Concrete Association
NSA	National Slag Association
OSW	Office of Solid Waste
PaLATE	Pavement Life-Cycle Assessment Tool for Environmental and Economic Effects
RCC	Resource Conservation Challenge
RCRA	Resource Conservation and Recovery Act
RMA	Rubber Manufacturers Association
RMRC	Recycled Materials Resource Center
SCA	Slag Cement Association
SFO	Solicitations for Offers
TPM	Technical Performance Measures
USDA	U.S. Department of Agriculture
USGBC	U.S. Green Building Council
USGS	U.S. Geological Survey
WaRM	Waste Reduction Model
WBDG	Whole Building Design Guide
WisDOT	Wisconsin Department of Transportation

I. OVERVIEW OF INDUSTRIAL MATERIALS RECYCLING

U.S. EPA Industrial Materials Recycling (IMR) Program

Homepage for the Industrial Materials Recycling Program that provides a general overview of industrial materials and their opportunities for reuse and recycling.

www.epa.gov/industrialmaterials/

The Industrial Resources Council (IRC)

The IRC is a collaboration of seven manufacturing industry associations working under the umbrella of the National Recycling Coalition to promote the appropriate beneficial use of materials generated by the nation's manufacturing sector. These industry trade associations represent coal combustion products, foundry sands, iron and steel slag, wood and pulp materials, rubber materials, and construction and demolition materials. The IRC's website provides comprehensive technical information on utilizing industrial materials in various road construction applications, including structural fill, embankments, road base, etc.

<http://www.industrialresourcescouncil.org/>

Overview of the Industrial Resources Council

Presentation by Kate Krebs, Executive Director of the National Recycling Coalition (NRC), to EPA January 23, 2007, provides an introduction to the NRC's newly formed Industrial Resources Council.

<http://www.epa.gov/epawaste/conserve/rrr/imr/irc-meet/01-nrc.pdf>

Beneficial Use of Industrial Materials Summit

The Summit is an annual meeting designed to serve as a forum for information exchange about the recycling and beneficial use of industrial materials between regulators and industry. The website for the Summit provides links to past summit agendas, speaker biographies, and presentations under the tab for "Past Summits" and other diverse information and resources addressing recycling and beneficially using industrial materials. www.beneficialusesummit.com

U.S. EPA Comprehensive Procurement Guidelines (CPG)

Contains information and links to construction and transportation products containing recycled content. Although the CPGs are primarily for federal procuring agencies, the information is useful to state and local governments and the private sector. You also can also view EPA's recommended recycled-content ranges and access a Supplier Database which includes manufacturers, vendors, and suppliers for each item. www.epa.gov/cpg/products.htm

Beneficial Reuse of Industrial Byproducts in the Gulf Coast Region

This U.S. EPA report examines the beneficial use opportunities for the major industrial byproduct streams generated by 9 sectors that have significant presence in the Gulf coast region. The report summarizes state beneficial material reuse programs in that region, and offers a detailed summary of factors that support or inhibit the creation of market connections to the reuse of industrial byproducts (i.e., drivers & barriers). The report is intended to provide information to state and federal regulators, trade associations, and other stakeholders to support

and promote beneficial material reuse. <http://www.epa.gov/sectors/pdf/beneficial-reuse-report.pdf>

II. INDUSTRIAL MATERIALS 101

A. COAL COMBUSTION PRODUCTS

U.S. EPA Coal Combustion Products Partnership (C²P²) Homepage

Provides information on the partnership program; describes the various coal combustion products, benefits, applications of CCPs and case studies of those applications; and provides resources concerning EPA's regulatory determination of CCPs.

<http://www.epa.gov/epawaste/partnerships/c2p2/index.htm>

U.S. Department of Energy Coal Utilization Byproducts (CUB) Homepages

DOE's Coal Utilization Byproduct Program website includes information on their CUB utilization and environmental research projects. The Coal Utilization Byproduct Research website contains a list of research and development projects funded by DOE addressing coal, petroleum, and natural gas topics. Both these Websites provide information on DOE's efforts to ensure that as the electric power industry continues to adopt cleaner and more advanced coal technologies, the recycling of coal combustion byproducts in beneficial applications can continue and expand.

Coal Utilization Byproducts Program

www.netl.doe.gov/technologies/coalpower/ewr/coal_utilization_byproducts/index.html

Coal Utilization Byproduct Research

www.fossil.energy.gov/programs/powersystems/pollutioncontrols/overview_coal_byproducts.html

National Technology Laboratory Database of State Regulations Affecting Disposal and Utilization of Coal Combustion By-Products

Contains summary information on current regulations in each state, drawn from the American Coal Ash Association's biannual report *State Solid Waste Regulations Governing the Use of Coal Combustion Byproducts*.

www.netl.doe.gov/technologies/coalpower/ewr/coal_utilization_byproducts/states/stateregs.html

American Coal Ash Association (ACAA)

The ACAA is a not-for profit 501(c) (6) organization that promotes the beneficial use of coal combustion products (CCPs). www.acaa-usa.org/

Coal Combustion Products Basics

Presentation by David Goss, Executive Director, American Coal Ash Association, to U.S. EPA January 23, 2007, provides information on the production of CCPs and their recycling and beneficial use applications.

<http://www.epa.gov/epawaste/conserve/rrr/imr/irc-meet/05-coal.pdf>

American Coal Ash Association's Compilation of Regulations, Standards, Guidelines, Websites, and Other References Pertinent

<http://www.epa.gov/epawaste/conserve/rrr/imr/pdfs/acaadoc.pdf>

Coal Ash Research Center at the University of North Dakota Energy & Environmental Research Center (EERC)

The Coal Ash Research Center is dedicated to improving the technical and economic aspects of coal ash by-product management. Their website provides educational and technical resources for utilizing coal combustion products, such as state environmental and transportation regulations and the *Buyer's Guide to Coal Ash Containing Products*.

www.undeerc.org/carrc/index.html

Review of State Regulations, Standards, and Practices related to the Use of Coal Combustion Products

The EERC conducted a series of state reviews sponsored by the U.S. EPA and U.S. DOE that examines a specific state's experience in addressing the beneficial use of coal combustion products:

NEW!

Review of North Dakota Regulations, Standards, and Practices Related to the Use of Coal Combustion Products. Final Report, April 2008

<http://www.epa.gov/epawaste/partnerships/c2p2/pubs/ndreview08.pdf> .

Review of Pennsylvania Regulations, Standards, and Practices Related to the Use of Coal Combustion Products. Final Report, March 2007 <http://www.epa.gov/epawaste/partnerships/c2p2/pubs/tdb-pastate.pdf>

Review of Florida Regulations, Standards, and Practices Related to the Use of Coal Combustion Products. Final Report, April 2006

www.undeerc.org/carrc/Assets/TB-FLStateReviewFinal.pdf

Review of Texas Regulations, Standards, and Practices Related to the Use of Coal Combustion Products. Final Report, January 2005

www.undeerc.org/carrc/Assets/TXStateReviewFinalReport.pdf

NEW!

National Synthesis Report on Regulations, Standards, and Practices Related to the Use of Coal Combustion Products. Final Report, December 2007

Following the completion of the series of individual state reviews, EERC prepared a synthesis report, funded by EPA and DOE NETL, to translate the results from the three in-depth state reviews into a national perspective on the status of CCP regulations, standards, and practices.

<http://www.epa.gov/epawaste/partnerships/c2p2/pubs/natpracc08.pdf>

Engineering and Environmental Specifications of State Agencies for Utilization and Disposal of Coal Combustion Products:

Volume 1 – DOT Specifications 2005-EERC-07-04

Volume 2 - Environmental Regulations 2005-EERC-07-05

The EERC developed two reports presenting State transportation and environmental regulations governing the use of coal combustion products. Volume 1 presents a state by state comparison of U.S. Department of Transportation specifications. Volume 2 presents a comparison of state environmental laws and regulations authorizing beneficial reuse of coal combustion by-products. <http://www.undeerc.org/carrc/Assets/Vol1DOT.pdf>; <http://www.undeerc.org/carrc/Assets/Vol2Environmental.pdf>

Electric Power Research Institute Project 49.001 Characterization of Coal Combustion Products (CCP)

This project provides laboratory and field information on CCP characteristics, including their chemical composition and leaching characteristics. Current research focuses on changes to CCP characteristics as a result of new air emission control technologies, laboratory leaching methods and leaching models, and characterization of field leachates. EPRI has developed a large database on CCP characteristics, and additional data will be developed as new control technologies evolve.

http://mydocs.epri.com/docs/Portfolio/PDF/2008_P049.pdf

U.S. Geological Survey (USGS) Energy Resources Program (ERP)

The Energy Resources Program of the U.S. Geological Survey provides information from impartial, comprehensive research investigations of geologic energy resources, including: petroleum (oil, natural gas, and natural gas liquids), coal, gas hydrates, geothermal resources, oil shale, oil sands, uranium, and heavy oil and natural bitumen. Specifically for coal, ERP promotes and supports coal research to improve the understanding of the nation's coal resources. Their main focus on coal is to support investigations into current issues pertaining to coal production, beneficiation and conversion, and the environmental impacts of the coal combustion process and coal combustion products.

U.S. Geological Survey Fact Sheet 2006-3128: Energy Resources Program

<http://pubs.usgs.gov/fs/2006/3128/>

Fly Ash: From Cradle to Grave

A USGS report consisting of a tutorial given on June 10, 2007 at the 32nd International Technical Conference on Coal Utilization & Fuel Systems, The Power of Coal, Clearwater Coal Conference in Clearwater, Florida, USA. This tutorial covers USGS' approach to their coal quality and coal combustion products studies. <http://pubs.usgs.gov/of/2007/1160/>

Characterization and Modes of Occurrence of Elements in Feed Coal and Coal Combustion Products from a Power Plant Utilizing Low-Sulfur Coal from the Powder River Basin, Wyoming

<http://pubs.usgs.gov/sir/2004/5271/>

U.S. Geological Survey Fact Sheet 0038-02: Characterization and Modes of Occurrence of Elements in Feed Coal and Fly Ash—An Integrated Approach

<http://pubs.usgs.gov/fs/fs-0038-02/>

Combustion Byproducts Recycling Consortium (CBRC)

The CBRC is a program that promotes and supports the commercially viable and environmentally sound recycling of coal combustion byproducts for productive uses through scientific research, development, and field testing. The CBRC is funded by the U.S. Department of Energy's National Energy Technology Laboratory; and is managed by the West Virginia Water Research Institute at West Virginia University with regional management by Southern Illinois University, the University of North Dakota, and the University of Kentucky.

<http://www.nrcce.wvu.edu/programs/cbrc/index.cfm>

NEW!

New Technology-Based Approach to Advance Higher Volume Fly Ash Concrete with Acceptable Performance - Final Report, August 2008

This report by the National Ready Mixed Concrete Association provides technical information about how to use high volume fly ash in concrete. The report was co-funded by the U.S. Department of Energy and the Combustion Byproducts Recycling Consortium. <http://www.rmc-foundation.org/>

Flue Gas Desulfurization (FGD) Gypsum

The FGDProducts.org Website provides educational, technical, and environmental information about the beneficial uses of FGD gypsum, a coal combustion product from coal-fired power plants. The Website is sponsored by the ACAA's Educational Foundation, Electric Power Research Institute, U.S. EPA's Coal Combustion Products Partnership, USDA – Agricultural Research Service, the Ohio State University, and the U.S. Department of Energy. www.fgdproducts.org/

Headwaters Resources

Headwaters is a marketer and supplier of coal combustion products, such as fly ash. The Resource Library section on their Website provides general and technical information, including case studies and technical bulletins on utilizing coal combustion products. www.flyash.com/resourcelibrary.asp

B. CONSTRUCTION & DEMOLITION (C&D) MATERIALS

EPA's C&D Materials Homepage

Provides information on C&D materials recycling, including case studies, tools, and links to additional resources. www.epa.gov/CDmaterials

RCRA in Focus C&D, EPA-530-K-04-005

Contains frequently asked questions about the Resource Conservation and Recovery Act (RCRA) regulatory impacts on C&D materials management, addresses special issues in C&D materials, hazardous waste requirements checklist, and how to reduce the amount of waste you generate. Also provides a summary of other environmental laws affecting the construction industry. <http://www.epa.gov/epawaste/inforesources/pubs/infocus/rif-c&d.pdf>

Construction Materials Recycling Association (CMRA)

The CMRA is a 501(c)(3) organization that promotes the recycling of construction and demolition materials. www.cdrecycling.org/

Construction & Demolition Materials

Presentation by William Turley, Executive Director, Construction Materials Recycling Association, to U.S. EPA January 23, 2007.

<http://www.epa.gov/epawaste/conserve/rrr/imr/irc-meet/02-cd.pdf>

National Demolition Association (NDA)

The NDA is a non-profit trade organization that promotes recycling and reducing the volume of demolition debris being landfilled. The goals of their Environmental Committee include, monitoring and reporting on American and Canadian recycling, salvage, scrap and de-construction trends; monitoring regulations and laws governing the movement of and recycling of demolition debris waste stream in the U.S.; and researching new or potential markets for the recycled products from demolition debris.

<http://demolitionassociation.com/index.php>

Associated General Contractors of America (AGC)

AGC is a national trade association representing companies in the commercial construction industry for both public and private entities including building, heavy, highway, and municipal projects. The “Environment” section of their website provides information on key environmental issues, including C&D recycling that impact the construction industry. www.agc.org/cs/environment

California Integrated Waste Management Board (CIWMB)

Provides information on C&D recycling tools for contractors, local governments, and processors. www.ciwmb.ca.gov/ConDemo/Tools.htm

WasteCap Wisconsin

WasteCap Wisconsin, Inc. is a statewide, nonprofit, industry supported 501(c)(3) organization that provides waste reduction and recycling assistance to businesses. WasteCap assists and encourages companies to effectively drive costs out of their operations through improved solid waste management practices. Their website provides tools and resources for C&D recycling.

www.wastecapwi.org/

“Recycling Construction Materials: An Important Part of the Construction Process”

An article written by U.S. EPA Office of Solid Waste staff for Construction Business Owner Magazine, June 2007.

www.constructionbusinessowner.com/topics/environment-and-compliance/recycling-construction-materials-an-important-part-of-the-construction-process.html

Construction Industry Compliance Assistance Center (CICA)

The CICA center is an EPA-funded environmental compliance assistance website for contractors and builders/developers. Developed by the National Center for

Manufacturing Sciences, in partnership with the Associated General Contractors of America, the National Association of Home Builders, the American Road and Transportation Builders Association, and the Golf Course Builders Association of America, the CICA center provides information and guidance on applicable environmental requirements and ways to save money through pollution prevention techniques. It also contains a C&D materials State Resource Locator, where contractors can find state and municipal recycling programs. www.cicacenter.org

Asphalt Shingles

ShingleRecycling.org, developed by the Construction Materials Recycling Association in partnership with U.S. EPA Region 5 and the University of Florida, provides information on asphalt shingle recycling, including state experience, markets, environmental regulations, worker health and safety, and links to additional resources. <http://shinglerecycling.org/>

Concrete

ConcreteRecycling.org, developed by the Construction Materials Recycling Association, is an online reference tool that provides information about concrete recycling. www.concreterecycling.org/

Chromated Copper Arsenate (CCA)-Treated Wood

CCAResearch.org, developed and funded by the Florida Department of Environmental Protection, the National Science Foundation and the Bill Hinkley Center for Solid and Hazardous Waste Management, this Website provides research information on CCA-treated wood. <http://www.ccaresearch.org/>

Drywall

DrywallRecycling.org, developed by the Construction Materials Recycling Association under a grant from U.S. EPA Region 5, provides information on drywall recycling, including state experiences, markets, and links to published studies. www.drywallrecycling.org/

Recycled Asphalt Pavement

The Asphalt Recycling and Reclaiming Association (ARRA) is a non-profit organization that promotes asphalt recycling and reclamation. Their Website includes presentations and papers on asphalt recycling techniques, and preview chapters for *The Basic Asphalt Recycling Manual*. www.arra.org/

Asphalt Contractor

Asphalt Contractor is an on-line magazine dedicated to asphalt producers and contractors. The magazine provides hot mix asphalt material producers, highway contractors and public works officials with critical "how-to" information on the process of HMA production, paving, and compaction. <http://www.forconstructionpros.com/cover/Asphalt-Contractor/2FCP>

C. FOUNDRY SANDS

U.S. EPA Resource Conservation Challenge: Foundry Sand Homepage

Provides tools, case studies, and other information about the recycling and beneficial use of foundry sand. <http://www.epa.gov/epawaste/conserved/rrr/imr/foundry/index.htm>

U.S. EPA Sector Strategies Program: Metalcasting

The EPA Sector Strategies Program achieves performance improvement and burden reduction in 13 sectors, including metalcasting, by addressing issues and challenges in a collaborative setting. Working collaboratively with stakeholders interested in the metalcasting sector, the Sector Strategies Program developed the "State Toolkit for Developing Beneficial Reuse Programs for Foundry Sand" and "Beneficial Reuse of Foundry Sand: A Review of State Practices and Regulations" documents.

Sector Strategies Metalcasting Homepage

Provides links and information related to the metalcasting sector including foundry sand reuse. www.epa.gov/opisdpdw/metalcasting/index.html

Beneficial Reuse of Foundry Sand Homepage

Provides information on the beneficial use of foundry sand and foundry sand documents published by the Sector Strategies Program, www.epa.gov/opisdpdw/metalcasting/foundry.html:

State Toolkit for Developing Beneficial Reuse Programs for Foundry Sands

Developed in partnership with the Association of Territorial Solid Waste Management Officials (ATSWMO) as an assistance tool for states, the guide is designed to address state program barriers and to help states initiate or revise their beneficial reuse programs in a way that increases safe beneficial reuse of foundry sand. The Toolkit provides program options and real-life examples of a variety of approaches used in states to efficiently conduct beneficial reuse determinations www.epa.gov/opisdpdw/metalcasting/toolkit_bw.pdf

Beneficial Reuse of Foundry Sand: A Review of State Practices and Regulations

This guide provides an overview of each state's regulations (current as of 2002) for beneficial reuse of foundry sand. www.epa.gov/opisdpdw/metalcasting/reuse.pdf

Foundry Industry Recycling Starts Today (FIRST)

FIRST is a 501(c)(3) organization that promotes the beneficial use and recycling of foundry sands and other metalcasting byproducts. The Foundry Recycling Website maintained by FIRST provides educational and technical resources on the recycling and reuse of spent foundry sands. www.foundryrecycling.org

Market Development Opportunities for Foundry Sands and Slags

Presentation by Elizabeth Olenbush, Executive Director of the Foundry Industry Recycling Starts Today, to EPA January 23, 2007.

<http://www.epa.gov/epawaste/consERVE/rrr/imr/irc-meet/04-foundry.pdf>

American Foundry Society (AFS)

The American Foundry Society is a national trade association and technical society for the metal casting industry. Their technical library includes prior industry research and publications regarding beneficial use and recycling of foundry industry byproducts.

www.afslibrary.com/

The Foundry Industry...Recycling Yesterday, Today & Tomorrow

American Foundry Society brochure on the industry's efforts to recycle at all phases of the metalcasting process.

www.afsinc.org/images/stories/govaffairs/recyclingbrochure_lr.pdf

University of Wisconsin's Beneficial Use Information Center (BUIC)

The BUIC is a virtual center created by the Geotechnical/Geoenvironmental Group at the Department of Civil and Environmental Engineering at the University of Wisconsin-Madison to provide a location where designers and users can access information relevant to the beneficial reuse of foundry by-products.

<http://geoserver.cee.wisc.edu/buic/index.html>

D. PULP AND PAPER BYPRODUCTS

National Council for Air and Stream Improvement Inc. (NCASI)

NCASI is an independent, non-profit research institute that focuses on environmental topics of interest to the forest products industry. NCASI's publications include Technical Bulletins, Special Reports, alerts, newsletters, and handbooks that are available primarily only to its members. www.ncasi.org/publications/default.aspx

Management of Byproduct Solids Generated in the Pulp and Paper Industry

Presentation by William Thacker, Ph.D., Senior Research Engineer of the National Council for Air and Stream Improvement, to EPA January 23, 2007.

<http://www.epa.gov/epawaste/consERVE/rrr/imr/irc-meet/03-paper.pdf>

Compilation of alternative Landfill Cover Experience using Wastewater Treatment Plant Residuals: NCASI Technical Bulletin No. 900

A report containing information on the use of paper industry wastewater treatment residuals as hydraulic barrier material in landfill covers. This was developed by the NCASI Northern Regional Center and partially funded by a U.S. EPA Region 5 Beneficial Use Demonstration grant.

www.ncasi.org/Publications/Detail.aspx?id=2771

E. SCRAP TIRES

EPA's Scrap Tire Recycling Homepage

The Website provides tools, information, and case studies on recycling scrap tires.

<http://www.epa.gov/osw/conserve/materials/tires/workgroup.htm>

Rubber Manufacturers Association (RMA)

RMA is the national trade association for the elastomer products industry. The Association supports and promotes the recycling of scrap tires in a variety of applications. Their website includes information on scrap tire markets, environmental issues, and state regulations under the "Scrap Tires" tab. www.rma.org/scrap_tires/

Beneficial Use of Tire Shreds in Civil Engineering Applications

Presentation by Mike Blumenthal, Vice President, Environment and Resource Recovery of the Rubber Manufacturers Association (previously held the position of Senior Technical Director), to EPA January 23, 2007.

<http://www.epa.gov/epawaste/conserve/rrr/imr/irc-meet/07-tires.pdf>

NEW!

Rubber Pavements Association (RPA)

RPA is an association that promotes the usage of recycled scrap tire rubber in asphalt pavements. RPA conducts workshops, seminars and conferences; publishes a quarterly newsletter and other informational materials; and maintains an on-line library of asphalt-rubber research documents. <http://www.rubberpavements.org/index.html>

F. BLAST AND STEEL FURNACE SLAGS

National Slag Association (NSA)

The NSA is a non-profit organization that promotes the beneficial use of blast and steel furnace slags. Their website contains information on educational and technical resources for recycling slags.

www.nationalslag.org/

Iron and Steel Slag: The Ultimate Renewable Resource

Presentation by Terry Wagaman, former President of the National Slag Association, to EPA January 23, 2007.

<http://www.epa.gov/epawaste/conserve/rrr/imr/irc-meet/06-slag.pdf>

Slag Cement Association (SCA)

The SCA is an organization that promotes the recycling of slag cement also known as ground granulated blast furnace slag in cement and concrete applications. Their website provides information on education and technical resources, including specifications, products and applications, and highlights of innovative projects that have used slag cement. www.slagcement.org/

III. STATE BENEFICIAL USE REGULATIONS, PROGRAMS; AND RISK ASSESSMENT RESOURCES

Association of State and Territorial Solid Waste Management Officials (ASTSWMO) Beneficial Use Survey November 2007

Report prepared by the ASTSWMO Beneficial Use Task Force is a compilation of information from a 2006 survey of State and Territorial beneficial use programs/decision-making processes for non-hazardous, industrial solid wastes. Forty States responded. It updates the April 2000 report and provides additional information.

<http://www.astswmo.org/files/publications/solidwaste/2007BUSurveyReport11-30-07.pdf>

ASTSWMO Beneficial Use Survey April 2000

<http://www.astswmo.org/files/publications/solidwaste/Beneficial-Use-Survey-Report.pdf>

State Profiles for Delaware, District of Columbia, Maryland, New Jersey, New York, Pennsylvania, Virginia, and West Virginia

Summary of the regulations for the beneficial use of industrial materials for select states.

www.greenhighways.org/Recycling_Profiles_State.cfm

Beneficial Use of Solid Waste in Maine

Website created by The University of Maine (UMaine) that contains environmental and engineering data on industrial waste materials with potential for beneficial use. UMaine developed this Website for the Beneficial Use Advisory Group comprised of stakeholders from industry, construction, manufacturing, legal, consulting, university, and state agencies in Maine. The Advisory Group's purpose is to review issues related to beneficial use with the broader goal of increasing beneficial use of secondary materials in Maine.

<http://useit.umaine.edu/>

Northeast Waste Management Officials' Association (NEWMOA) Beneficial Use Resources

NEWMOA established a Beneficial Use Determination (BUD) Workgroup that has produced several resources for state use only: a searchable database of all the BUDs that have been issued by the NEWMOA states plus five additional other states; and a table comparing the BUD application requirements of the NEWMOA states. In addition, the Workgroup produced fact sheets for the public on selected waste/use combinations. www.newmoa.org/solidwaste/bud.cfm

DOE National Technology Laboratory Database of State Regulations Affecting Disposal and Utilization of Coal Combustion By-Products

Contains summary information on current regulations in each state, drawn from the American Coal Ash Association's biannual report *State Solid Waste Regulations Governing the Use of Coal Combustion Byproducts*.

www.netl.doe.gov/technologies/coalpower/ewr/coal_utilization_byproducts/states/stateregs.html

Engineering and Environmental Specifications of State Agencies for Utilization and Disposal of Coal Combustion Products: Volume 2 - Environmental Regulations 2005-EERC-07-05

The Energy & Environmental Research Center at the University of North Dakota developed two

reports presenting State transportation and environmental regulations governing the use of coal combustion products. Volume 1 presents a state by state comparison of U.S. Department of Transportation specifications. Volume 2 presents a comparison of state environmental laws and regulations authorizing beneficial reuse of coal combustion by-products.

<http://www.undeerc.org/carrc/Assets/Vol2Environmental.pdf>

Review of State Regulations, Standards, and Practices related to the Use of Coal Combustion Products

The Energy and Environmental Center at the University of North Dakota conducted a series of state reviews sponsored by the U.S. EPA and U.S. DOE that examines a specific state's experience in addressing the beneficial use of coal combustion products.

NEW!

Review of North Dakota Regulations, Standards, and Practices Related to the Use of Coal Combustion Products. Final Report, April 2008

<http://www.epa.gov/epawaste/partnerships/c2p2/pubs/ndreview08.pdf> .

Review of Pennsylvania Regulations, Standards, and Practices Related to the Use of Coal Combustion Products. Final Report, March 2007

<http://www.epa.gov/epawaste/partnerships/c2p2/pubs/tdb-pastate.pdf>

Review of Florida Regulations, Standards, and Practices Related to the Use of Coal Combustion Products. Final Report, April 2006

www.undeerc.org/carrc/Assets/TB-FLStateReviewFinal.pdf

Review of Texas Regulations, Standards, and Practices Related to the Use of Coal Combustion Products. Final Report, January 2005

www.undeerc.org/carrc/Assets/TXStateReviewFinalReport.pdf

NEW!

National Synthesis Report on Regulations, Standards, and Practices Related to the Use of Coal Combustion Products. Final Report, December 2007

Following the completion of the series of individual state reviews, EERC prepared a synthesis report, funded by EPA and DOE NETL, to translate the results from the three in-depth state reviews into a national perspective on the status of CCP regulations, standards, and practices.

<http://www.epa.gov/epawaste/partnerships/c2p2/pubs/natpraccc08.pdf>

U.S. EPA's Regulatory Determinations on CCPs

EPA published two regulatory determinations on the management and use of coal combustion products, in 1993 and in 2000. In these two regulatory determinations, EPA did not identify any environmental harm associated with the beneficial use of coal combustion products and concluded in both determinations that these materials did not warrant regulation as a hazardous waste. The beneficial use of coal combustion products can include both encapsulated and unencapsulated applications.

<http://www.epa.gov/epawaste/conservation/rrr/imr/ccps/resources.htm>

EPA State Toolkit for Developing Beneficial Reuse Programs for Foundry Sands

The EPA Sector Strategies Program developed the "State Toolkit for Developing Beneficial Reuse Programs for Foundry Sand" document to help address state program barriers. Developed

in partnership with the Association of Territorial Solid Waste Management Officials as an assistance tool for states, the guide is designed to help states initiate or revise their beneficial reuse programs in a way that increases safe beneficial reuse of foundry sand. The Toolkit provides program options and concrete examples of a variety of approaches used in states to efficiently conduct beneficial reuse determinations
www.epa.gov/opispdwb/metalcasting/toolkit_bw.pdf

Beneficial Reuse of Foundry Sand: A Review of State Practices and Regulations

The EPA Sector Strategies Program developed the “Beneficial Reuse of Foundry Sand: A Review of State Practices and Regulations” guide to provide an overview of each state's regulations (current as of 2002) for beneficial reuse of foundry sand.
www.epa.gov/opispdwb/metalcasting/reuse.pdf

STATE BENEFICIAL USE PROGRAM WEBSITES

Arkansas Guidance for Determining Beneficial Use

www.adeq.state.ar.us/solwaste/branch_technical/pdfs/20Guidance_Beneficial_Use_031020.pdf

Connecticut Beneficial Use of Solid Waste

www.ct.gov/dep/cwp/view.asp?a=2718&q=325332&depNav-GID=1646

Florida Beneficial Uses of Waste

www.dep.state.fl.us/waste/categories/solid_waste/pages/beneficialuse.htm

Indiana Non-Rule Policy Documents (foundry sand and tire chips)

Waste-0027 Storage of Type III Foundry Sand Prior to Legitimate Use

Waste-0028 Use of Foundry Sand in Accordance with House Enrolled Act 1541

Waste-0040 Use of Foundry Sand in Land Application and as a Soil Amendment

Waste-0058 Use of Waste Tire Chips in On-Site Sewage Systems

<http://www.in.gov/idem/4694.htm>

Iowa Beneficial Use Determination

www.legis.state.ia.us/Rules/Current/iac/567iac/567108/567108.pdf

Kentucky Beneficial Reuse Forms

Solid Waste Permit-By-Rule Application Form

www.waste.ky.gov/NR/rdonlyres/60D65355-1BD2-450E-A033-065C61DF3643/0/7098BeneficialReuse7_99.pdf

Special Waste Beneficial Reuse Registered Permit-By-Rule Application Form

www.waste.ky.gov/NR/rdonlyres/348BADE2-6137-4B4A-9AA7-A245F6C5D753/0/7059FRPBRSpWBeneReuse.pdf

Maine

Beneficial Use

www.maine.gov/dep/rwm/solidwaste/beneficialuse.htm

Chapter 400 Beneficial Use Definition

www.maine.gov/sos/cec/rules/06/096/096c400.doc

Chapter 418 Beneficial Use Regulations

www.maine.gov/sos/cec/rules/06/096/096c418.doc

Applications for Beneficial Use

www.maine.gov/dep/rwm/solidwaste/forms/beneficialuse.htm

Massachusetts**Draft Beneficial Use Determination (BUD) Guidance, March 2004**

www.mass.gov/dep/recycle/laws/polarchv.htm

Beneficial Use Determination Form

www.mass.gov/dep/recycle/approvals/swforms.htm#beneficial

Michigan**Part 115 Rules**

<http://www.deq.state.mi.us/documents/deq-wmd-swp-pt115rls.pdf>

Minnesota**Beneficial Use of Solid Waste Rule (Minnesota Rule 7035.2860)**

<https://www.revisor.leg.state.mn.us/rules/?id=7035.2860>

Solid Waste Utilization Regulations

www.pca.state.mn.us/waste/sw-utilization.html

Land Application of Industrial By-Products

www.pca.state.mn.us/water/landapp.html

Mississippi**Beneficial Use Program**

http://www.deq.state.ms.us/MDEQ.nsf/page/SW_MississippiBeneficialUseProgram?OpenDocument

Regulations for the Beneficial Use of Non-hazardous Solid Waste

This website is the first page for querying a database. To access Mississippi's beneficial use regulations, click on the arrow next to "Non Hazardous Waste", then click on "SW-9".

www.deq.state.ms.us/newweb/MDEQRegulations.nsf?OpenDatabase

Beneficial Use Determination Form

[http://www.deq.state.ms.us/MDEQ.nsf/pdf/SW_RequestFormforBeneficialUseDetermination082007/\\$File/Request%20Form%20for%20a%20Beneficial%20Use%20Determination%207-08.pdf?OpenElement](http://www.deq.state.ms.us/MDEQ.nsf/pdf/SW_RequestFormforBeneficialUseDetermination082007/$File/Request%20Form%20for%20a%20Beneficial%20Use%20Determination%207-08.pdf?OpenElement)

Nebraska

Beneficial Use of Coal Combustion and Steel Manufacturing By-Products; and Other Similar Materials

<http://www.epa.gov/epawaste/conserve/rrr/imr/pdfs/nebraska.pdf>

New Hampshire

Certified Waste-Derived Products

http://des.nh.gov/organization/divisions/waste/swmb/pdrs/waste_derived.htm

Application to Certify a Waste-Derived Product for Distribution & Use

http://des.nh.gov/organization/divisions/waste/swmb/documents/waste_derived.pdf

Certification of Waste-Derived Products Env-SW 1500

<http://www.nh.gov/des/organization/commissioner/legal/rules/documents/env-sw1500.pdf>

New Jersey Beneficial Use Guidance

www.state.nj.us/dep/dshw/rrtp/bud.htm

New York Beneficial Use Determinations

www.dec.ny.gov/chemical/8821.html

North Carolina Requirements for Beneficial Use of Coal Combustion By-Products

www.wastenotnc.org/SWHOME/17RUL.htm

North Dakota

Coal Combustion Waste Regulatory Perspective

<http://www.ndhealth.gov/wm/Publications/CoalCombustionWasteRegulatoryPerspective.pdf>

Guideline 11 Ash Utilization For Soil Stabilization, Filler Materials And Other Engineering Uses

<http://www.ndhealth.gov/wm/Publications/Guideline11AshUtilizationForSoilStabilizationFillerMaterialsAndOtherEngineeringUses.pdf>

Guideline 21 Scrap Tire Management

<http://www.ndhealth.gov/wm/Publications/Guideline21ScrapTireManagement.pdf>

Ohio

Industrial Waste Beneficial Use Team Web Page

http://www.epa.state.oh.us/dsw/rules/industrial_waste_beneficial_use.html

Beneficial Use Rules Package

http://www.epa.state.oh.us/dsw/rules/draft_industrial_waste_beneficial_use_nov06.html

Management Directive: Division of Labor

www.epa.state.oh.us/dsiwm/document/guidance/gd_529.pdf

Evaluating Exempt Waste Uses at Solid Waste Facilities DSIWM Guidance

#609 www.epa.state.oh.us/dsiwm/document/guidance/gd_609.pdf

Disposal and Beneficial Use of Construction and Demolition Debris Guidance

#560 www.epa.state.oh.us/dsiwm/document/guidance/gd_560.pdf

Beneficial Uses of Scrap Tires Guidance #671

www.epa.state.oh.us/dsiwm/document/guidance/gd_671.pdf

Pennsylvania

Beneficial Use Program

www.depweb.state.pa.us/landrecwaste/cwp/view.asp?A=1239&Q=463067

General Permits - used for beneficial use approvals.

<http://www.depweb.state.pa.us/landrecwaste/cwp/view.asp?a=1239&Q=463116&landrecwasteNav=30804>

Permit Forms for Beneficial Use

www.depweb.state.pa.us/landrecwaste/cwp/view.asp?A=1239&Q=462836

Rhode Island

Beneficial Use Guidelines

www.dem.ri.gov/programs/benviron/waste/pdf/budpol.pdf

Vermont

Procedures for Addressing Acceptable Uses of Solid Waste

www.anr.state.vt.us/dec/wastediv/solid/pubs/Acceptable_Uses.pdf

Virginia Department of Environmental Quality

Reuse and Beneficial Use Determinations

www.deq.virginia.gov/waste/reuse.html

Virginia Administrative Code Chapter 85 Coal Combustion Byproduct Regulations

www.deq.virginia.gov/waste/pdf/wstregs/coalcomb.pdf

Washington

Beneficial Use Determination Website

www.ecy.wa.gov/programs/swfa/bud/

Wisconsin Department of Natural Resources

Beneficial Use of Industrial Byproducts Program Website

www.dnr.state.wi.us/org/aw/wm/solid/beneficial/

Chapter NR 538 Beneficial Use of Industrial Byproducts

www.legis.state.wi.us/rsb/code/nr/nr538.pdf

STATE MARKET DEVELOPMENT

Recycling Market Development

This web site provides recycling market development information for state and local officials, sources of technical and financial assistance for recycling businesses, and information on the economic benefits of recycling.

<http://www.epa.gov/epawaste/conserve/rrr/rmd/index.htm>

RISK ASSESSMENT RESOURCES

Evaluating Risk of Industrial Materials Recycling: A Compendium of Information and Tools

In collaboration with the states, EPA is developing a risk compendium to help state decision makers evaluate proposed beneficial uses for industrial materials. The compendium will introduce concepts that should be considered in assessing the risks of using industrial materials in various applications and will list existing tools, such as ground-water models, test methods, and state best practices, that stakeholders can use to answer the questions posed in the framework. The risk compendium is not yet available.

Industrial Waste Evaluation Model (IWEM)

The IWEM software is designed to assist individuals in determining the most appropriate waste management unit design to minimize or avoid adverse ground water impacts, by evaluating types of liners, the hydrogeologic conditions of the site, and the toxicity and expected leachate concentrations of the anticipated waste constituents. <http://www.epa.gov/epaoswer/non-hw/industd/tools/iwem/index.htm>

University of New Hampshire's Recycled Materials Resource Center (RMRC) Research Project#7/8 Risk Assessment Framework

Completed in March 2003, the RMRC partnered with the Minnesota Department of Transportation, the New York State Department of Environmental Conservation, and the Laboratoire Centrale des Ponts et Chaussées to develop a risk analysis framework for the

beneficial use of secondary materials in road construction. The RMRC is a national center that promotes the appropriate use of recycled materials in the highway environment; and is funded through a cooperative agreement with the Federal Highway Administration.

<http://www.rmrc.unh.edu/Research/past/P7&8/p7&8summary.pdf>

<http://www.rmrc.unh.edu/Research/past/P7&8/P7&8Final.pdf>

Steelmaking Slag: A Safe and Valuable Product, November 1998

A report prepared by Collier, Shannon, Rill & Scott, PLLC on behalf of the Steel Slag Coalition that considers the importance of steelmaking slag as a product and provides an overview of the regulatory status of steelmaking slag in the United States. In addition, the risk assessment process and results are summarized. www.nationalslag.org/riskpaper.htm

IV. ENVIRONMENTAL AND ECONOMIC BENEFITS RESOURCES

NEW!

EPA's C2P2 Website: Benefits of using CCPs

Using CCPs in an environmentally safe manner saves virgin resources, and reduces energy consumption and greenhouse gas emissions (GHG). In addition, it helps reduce the need for landfill space and new landfills. CCPs also makes good economic sense, they are often less costly than the materials they replace. This site gives an overview of these benefits.

<http://www.epa.gov/epawaste/partnerships/c2p2/use/benefits.htm>

Waste and Materials-Flow Benchmark Sector Reports: Beneficial Use of Secondary Materials

EPA funded the development of three reports to look at the costs and benefits of recycling the following industrial materials: coal combustion products, foundry sand, and construction and demolition materials. The purpose of these reports are to provide an initial assessment of the market dynamics that affect the generation, disposal, recovery, and beneficial use of these materials; and to provide a preliminary life cycle analysis of the beneficial impact of these materials.

- **Coal Combustion Products Report**
<http://www.epa.gov/epawaste/partnerships/c2p2/pubs/benuse07.pdf>
- **Foundry Sand Report** – not yet available
- **C&D Materials Report** – not yet available

WaRM (Waste Reduction Model)

Created by the U.S. Environmental Protection Agency (EPA) to help solid waste planners and organizations estimate greenhouse gas (GHG) emission reductions from several different waste management practices. WaRM is available in a web-based calculator format and as a Microsoft Excel[®] spreadsheet.

www.epa.gov/climatechange/wycd/waste/calculators/Warm_UsersGuide.html

BEES 4.0 (Building for Environmental and Economic Sustainability)

A software tool developed by the National Institute of Standards and Technology's Building and Fire Research Laboratory to select cost-effective, environmentally preferable building products. Version 4.0 includes actual environmental and economic performance data for 230 building

products for analysis and comparison. Audience: designers, builders, and product manufacturers.
www.bfrl.nist.gov/oae/software/bees.html

PaLATE (Pavement Life-Cycle Assessment Tool for Environmental and Economic Effects)

A computer-based decision support tool to model economic costs and environmental effects of using traditional highway materials and recycled materials for highway applications. PaLATE was developed by Professor Arpad Horvath at the University of California-Berkley's Department of Civil and Environmental Engineering and funded by the Recycled Materials Resource Center and the University of California Transportation Center. Audience: pavement designers and engineers, transportation agency decision-makers, civil engineers, and researchers.

www.ce.berkeley.edu/~horvath/palate.html. For a comprehensive presentation on the model, see: www.ncdot.org/doh/preconstruct/highway/geotech/trb/download/presentations/3a/02a%20--PaLATE.pdf

Beneficial Reuse Model (BenReMod)

BenReMod is a model that allows state and local regulators, end users, and the public to evaluate the benefits and disadvantages of using recycled materials in road construction. It is currently being developed by the University of Toledo in partnership with the American Coal Ash Association, Great Lakes Byproducts Management Association, and the Ohio Environmental Protection Agency. <http://benremod.eng.utoledo.edu/BenReMod/>

U.S. Climate Technology Cooperation Gateway's Greenhouse Gas (GHG) Equivalencies Calculator

The GHG Equivalencies Calculator is designed to enable public and private sector organizations and individuals to translate greenhouse gas reductions from units that are typically used to report reductions (e.g. metric tons of carbon dioxide equivalent) into terms that are easier to conceptualize (e.g. equivalent number of cars not driven for one year).

<http://www.epa.gov/cleanenergy/energy-resources/calculator.html>

Life Cycle Inventory of Slag Cement Concrete by the Slag Cement Association

A life cycle assessment published by the Slag Cement Association for concrete with slag cement used as a partial replacement for portland cement.

www.slagcement.org/download/123321_U128801_71549/Life+Cycle+Inventory+of+Slag+Cement+Concrete.pdf

By-products and Recycled Materials in Earth Structures: Materials and Applications

Finnish model study assessing fly ash and ground granulated blast furnace slag used in sub-base for roadways.

www.tekes.fi/eng/publications/By_products_and_Recycled_Materials.pdf

V. INDUSTRIAL MATERIALS RECYCLING – APPLICATIONS AND SPECIFICATIONS

A. RECYCLING AND REUSE OF INDUSTRIAL MATERIALS IN BUILDINGS

Material-specific information

Coal Combustion Products Partnership: Coal Combustion Products (CCPs) in Buildings

Provides information and guidance on finding and using CCPs in building applications, and includes links to related research, standards/specifications, and resources. <http://www.epa.gov/epawaste/partnerships/c2p2/use/build.htm>

NEW!

Using Recycled Industrial Materials in Buildings, EPA530-F-08-022, October 2008

Provides information on the use of recycled industrial materials in buildings as an alternative to virgin materials and buildings products. An electronic version of this document will be posted at www.epa.gov/industrialmaterials. For hard copies, please contact the National Service Center for Environmental Publications at 1-800-490-9198 or nscep@bps-lmit.com.

NEW!

Cold Weather Concrete Mix Design for the Beneficial Use of Coal Fly Ash as a Supplementary Cementitious Material, EPA530-F-08-011, June 2008

Provides information on cold weather mix design considerations for the use of coal fly ash as a supplementary cementitious material.

<http://www.epa.gov/epawaste/partnerships/c2p2/pubs/ccfsfnl.pdf>

NEW!

Reduce, Reuse, and Recycle Construction and Demolition Materials at Land Revitalization Projects, EPA560-F-08-242, April 2008

Provides information on opportunities to reuse and recycle materials generated during building construction, demolition, or renovation activities at brownfield properties. <http://www.epa.gov/epawaste/conservation/rrr/imr/cdm/pubs/brochure.pdf>

NEW!

Sustainable Construction with Coal Combustion Products: A Primer for Architects

Provides information on how coal combustion products can be used in the design of sustainable construction projects. For hard copies, please contact the American Coal Ash Association Educational Foundation at 720-870-7897 or info@aca-usa.org.

Sample contract language and project specifications

Federal Construction Guide for Specifiers

EPA collaborated with the Federal Environmental Executive and the Whole Building Design Guide (WBDG) to develop the *Federal Construction Guide for Specifiers* which provides comprehensive information for procuring green

building products and construction services within the Federal government.
www.wbdg.org/design/greenspec.php

California Integrated Waste Management Board's Designing With Vision:

Technical Manual for Material Choices in Sustainable Construction

See pages 27-32; includes good introductory language, examples, and references to other materials. www.ciwmb.ca.gov/GreenBuilding/Pubs.htm or www.p2pays.org/ref/34/33883.pdf

The DOE Building America Program's Cleveland EcoVillage

Sample specification language includes the sample specifications with notes about where it was used and the decision making process applied, along with guidance on the research required for using high levels of CCPs.

www.buildingscience.com/bsc/buildingamerica/casestudies/ecovillage/ecovillage_specs.pdf

King County Vashon Transfer/Recycling Station's Sample Technical Specifications

Includes specifications with a fly ash concrete requirement and link to the sustainable materials specification review report.

www.metrokc.gov/procure/green/vashon.htm#13

Minnesota Office of Environmental Assistance's Green Construction Brochure

Includes a good overview on selecting green building materials and some basic sample specification language. www.pca.state.mn.us/oea/greenbuilding/ecohome-construction.pdf

Region 8 Office (LEED 2.0 Silver certification) Environmental Provisions Included in the Solicitations for Offers (SFOs)

www.epa.gov/greeningepa/documents/denver_sfo_environ_508.pdf

Standard Specifications

American Society for Testing and Materials (ASTM) International

ASTM International is a voluntary standards development organization. ASTM has over 130 technical committees covering diverse industry areas ranging from metals to the environment. The technical committees are made up of professionals from around the world who develop ASTM standards. The *Standard/Annual Book of ASTM Standards* is composed of over 80 volumes and contains ASTM's 12,000 plus standards.

www.astm.org

The following ASTM Committees develop standards related to using recycled industrial materials:

ASTM Committee C01 Cement develops specifications, test methods, recommended practices, and terminology for hydraulic cements including portland, natural, pozzolanic, masonry and slag cements, and modifications and combinations during manufacture of the cements; and investigates the properties of hydraulic cements and promotes the improvement and uniformity of testing these materials.

ASTM Committee C09 Concrete and Concrete Aggregates has jurisdiction over 160 standards published in the *Annual Book of ASTM Standards, Volume 04.02*. These standards, together with the standards developed by ASTM Committee C01 on Cement and committees of the American Concrete Institute, are essential to the construction of civil infrastructure.

ASTM Committee C11 Gypsum and Related Building Material Systems develops specifications, test methods, and applications in the gypsum and related product industries.

ASTM Committee D04 Road and Paving Materials has jurisdiction over 200 standards, published in the *Annual Book of ASTM Standards, Volume 4*. These standards are essential to the construction and maintenance of highways, and other transportation construction.

ASTM Committee C12 Mortars and Grouts for Unit Masonry has jurisdiction of 15 standards, published in the *Annual Book of ASTM Standards, Volume 04.05*. These standards are essential to the industry of mortar used with masonry units, including burned clay, shale, sand-lime, concrete and stone.

ASTM Committee E06 Performance of Buildings has jurisdiction of over 245 standards, published in the *Annual Book of ASTM Standards, Volume 04.11 and 04.12*. These standards play a role in the building industry and address issues relating to the performance of buildings, their elements, components, and the description, measurement, prediction, improvement and management of the overall performance of buildings and building related facilities.

ASTM Committee E50 Environmental Assessment, Risk Management and Corrective Action has jurisdiction over 35 standards published in the *Annual Book of ASTM Standards, Volume 11.04*. These standards are essential to corrective action, pollution prevention and beneficial use.

ASTM Committee D34 Waste Management has jurisdiction over 125 standards published in the *Annual Book of ASTM Standards, Volume 11.04*. These standards are essential to all aspects addressing the generation, storage, transportation, treatment, recovery, and disposal of

wastes generated from industrial, commercial, residential, and institutional sources.

American Concrete Institute (ACI)

The ACI is a non-profit technical and educational society that serves as a forum for discussing and resolving issues related to concrete through conventions and meetings; the *ACI Structural Journal*, the *ACI Materials Journal*, *Concrete International*, and technical publications; chapter activities; and technical committee work. www.concrete.org/general/home.asp

The following ACI Committees address efforts to using recycled industrial materials:

ACI Committee 232 Fly Ash and Natural Pozzolans in Concrete

develops and reports information on the use of fly ash and natural pozzolans in concrete and mortar, including developing guidance on the use of higher volume fly ash concrete for the Green Building and industry performance guide specification; and works with the U.S. Green Building Council and others to promote sustainability as it relates to concrete.

ACI Committee 233 Ground Slag in Concrete develops and reports information on the use of ground slag in concrete and mortar.

ACI Committee 234 Silica Fume develops and reports information on the use of silica fume in concrete and mortar.

Cement Specifications	Concrete Specifications	Other Specifications
ASTM C 595, "Standard Specification for Blended Hydraulic Cements."	ASTM C 618, "Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete."	ASTM E 1266-88, "Standards Practice for Processing Mixtures of Lime, Fly Ash, and Heavy Metal Waste in Structural Fills and Other Construction Applications."
ASTM C 150, "Standard Specification for Portland Cement."	ASTM C 311, "Standard Methods of Sampling and Testing Fly Ash and Natural Pozzolans for Use as a Mineral Admixture in Portland Cement Concrete."	ASTM E 2277-03, "Standard Guide for Use of Coal Combustion By-Products in Structural Fills."
ASTM C1240-05, "Standard Specification for Silica Fume Used in Cementitious Mixtures."	ASTM C 989, "Ground Granulated Blast-Furnace Slag for Use in Concrete Mortars."	
--	ACI 226.R1, "Ground Granulated Blast-Furnace Slag as a Cementitious Constituent in Concrete."	
--	ACI 232.2R, "Use of Fly Ash in Concrete."	

National Ready Mixed Concrete Association (NRMCA)

The NRMCA is a trade association representing members of the ready mixed concrete industry from producers to those who sell goods and services supporting the industry. NRMCA's Research, Engineering and Standards Committee coordinates all standardization activities, including the development of specifications and recommended practices and works in cooperation with other standardization bodies such as the American Concrete Institute, American Society for Testing and Materials International, and transportation agencies in representing the ready mixed concrete industry. www.nrmca.org/

Green Building Resources

EPA Green Buildings Website

Brings together a collection of EPA programs that relate to green building. www.epa.gov/greenbuilding/

Whole Building Design Guide (WBDG)

The WBDG is a web-based portal providing government and industry practitioners with one-stop access to up-to-date information on a wide range of building-related guidance, criteria and technology from a 'whole buildings' perspective. Currently organized into three major categories—Design Guidance, Project Management and Operations and Maintenance—at the heart of the

WBDG are resource pages, and brief summaries on particular topics.
www.wbdg.org/

Memorandum of Understanding and Guiding Principles for Federal High Performing Buildings www.doi.gov/greening/buildings/SustBldgsMOU.pdf

DOE High Performance Buildings

Link to information about whole-building design, including costs and benefits; tools such as design guidelines, software, and brochures; and information about high performance building technologies such as methods, materials and equipment. www.eere.energy.gov/buildings/highperformance/

U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) Green Building Rating System

The Leadership in Energy and Environmental Design (LEED) Green Building Rating System is the nationally accepted benchmark for the design, construction, and operation of high performance green buildings.
www.usgbc.org/DisplayPage.aspx?CategoryID=19

Green Globes

The Green Globes system, developed by the Green Building Initiative, is a green management tool that includes an assessment protocol, rating system and guide for integrating environmentally friendly design into commercial buildings. Once complete, it also is expected to facilitate recognition of the project through third-party verification. The Green Building Initiative is a non-profit organization that promotes practical green building approaches for residential and commercial construction.
www.thegbi.org/home.asp

Healthy Building Network's Pharos Project

The Healthy Building Network is a national network of green building professionals, environmental and health activists, socially responsible investment advocates and others who are interested in promoting healthier building materials as a means of improving public health and preserving the global environment. The Pharos Project strives to make building material evaluations as comprehensive as possible – encompassing health, sustainability and social justice issues throughout the lifecycle. To facilitate this vision, the (1) project proposes a framework of analysis based upon a set of categories, such as occupant exposure, renewable materials; (2) identifies an ideal goal in each category; and (3) establishes criteria for evaluating progress toward the ideal.
www.pharosproject.net/framework/index.php

NEW!

Lifecycle Building Challenge (LBC)

The LBC web site provides information on publications, case studies, and other resources on lifecycle building (designing building materials, components, information systems, and management practices to create buildings that facilitate and anticipate future changes to and eventual adaptation or dismantling for

recovery of all systems, components, and materials).

<http://www.lifecyclebuilding.org/index.php>

NEW!

Planning for a Sustainable Future: A Guide for Local Governments, EPA902-K-08-001, November 2008

Provides information and resources to help local governments integrate sustainable planning into their communities. Areas of opportunities include: green building and procurement, land use, and solid waste generation and recycling.

www.epa.gov/region02/sustainability/greencommunities

Case Studies – Buildings

EPA’s Coal Combustion Products Partnership (C²P²) Program Case Studies

Visit <http://www.epa.gov/epawaste/partnerships/c2p2/cases/index.htm> for a comprehensive listing of case studies exhibiting the use of coal combustion products. Featured building case studies include:

HVFA in the Madera Project - A Green & Profitable Residential Community Development

This C²P² case study presents the use of high volume fly ash in the Madera Community residential development.

<http://www.epa.gov/epawaste/partnerships/c2p2/cases/08-madera.pdf>

Lewis & Clark Fort Mandan Visitor Services Center

This C²P² case study presents the use of coal combustion products in a wide array of building applications, including the surrounding site.

<http://www.epa.gov/epawaste/partnerships/c2p2/cases/01-lewis.pdf>

NEW!

American Electric Power and Certainteed Put Environmental Process Byproduct to Beneficial Use in Wallboard

This C²P² case study presents the use of flue gas desulfurization gypsum, a coal combustion product, in the manufacture of wallboard.

<http://www.epa.gov/epawaste/partnerships/c2p2/cases/22-gypsum.pdf>

National Slag Association (NSA) Building-Related Case Studies

The NSA website provides several cases studies on the beneficial use applications for slag under the “Research/Library” tab.

Flatwork Concrete that Can Withstand Michigan’s Temperature Ups and Downs

A case study on one contractor’s success with using blast furnace slag aggregate in outdoor flatwork concrete such as sidewalks, driveways, and patios for residential areas. [www.nationalslag.org/archive/nsa_200-](http://www.nationalslag.org/archive/nsa_200-1_bf_slag_in_concrete_flatwork.pdf)

[1_bf_slag_in_concrete_flatwork.pdf](http://www.nationalslag.org/archive/nsa_200-1_bf_slag_in_concrete_flatwork.pdf)

Since 1774 slag has been mixing it up with cement. So what's new?

A case study on Texas Industries, Inc. and Chaparral Steel's patented steel slag process that increases the output of cement. This patented process helped meet the cement demands during the nationwide housing boom. www.nationalslag.org/archive/nsa_200-2_eaf_use_in_cement_mfg..pdf

Blast Furnace Slag Weighs In at Detroit Metro Airport's New Parking Garage

www.nationalslag.org/archive/nsa_2053_bf_slag_concrete_detroit_garage.pdf

Foundry Industry Starts Recycling Today (FIRST) Building Case Studies

The FIRST web site provides several case studies on the beneficial use applications for spent foundry sand under the "Technical Applications" tab. The initial case studies were developed for FIRST under a grant from U.S. EPA Region 5. Registered users of the foundryrecycling.org website can download these case studies. Registration is free. www.foundryrecycling.org/TechnicalApplications/CaseStudies/tabid/315/Default.aspx

Foundry Sand in Residential Home Construction

A case study on the use of foundry sand as structural fill for residential construction.

The City of Reedsburg Industrial Park

A case study on the use of spent foundry sand as structural fill for 35 acres of an industrial park.

Fort Worth Post Office Showcases Green Building

An Environmentally Preferable Purchasing case study highlights the sustainable features incorporated into the Fort Worth Post Office. www.epa.gov/epp/pubs/case/usps2.htm

USGBC LEED Case Studies

Searchable database to locate LEED certified projects across the U.S. <http://leedcasestudies.usgbc.org>

DOE High Performance Building Case Studies

www.eere.energy.gov/buildings/database/

U.S. EPA Green Buildings

To further carry out EPA's green building mission, beginning in FY 2006, EPA required all newly initiated major building construction projects achieve the LEED® (Leadership in Energy and Environmental Design) Gold standard as well as other sustainable features. www.epa.gov/greeningepa/projects/

Off the Shelf

Joint publication prepared by members of the Kansas City EPA Regional Headquarters building team, including EPA staff, U.S. General Services Administration (GSA) staff, and the building developer's staff, provides information on the Kansas City, Kansas Headquarters building.

http://www.epa.gov/greeningepa/documents/off_shelf.pdf

New England Regional Laboratory

On-line brochure highlighting the green building features, including recycled materials, used in the design of EPA's New England Laboratory.

www.epa.gov/ne/lab/greenbuilding/index.html#epm

EPA Region 10 Renovation

Describes efforts to explore environmentally responsible design and construction in the renovation of the 16th floor of the Park Place building.

<http://yosemite.epa.gov/r10/omp.nsf/webpage/Building+A+Green+Future?OpenDocument>

B. RECYCLING AND REUSE OF INDUSTRIAL MATERIALS IN ROADWAYS

U.S. EPA, Federal Highway Administration, & AASHTO Resources

Coal Combustion Products Partnership's (C2P2) Highway Applications

Provides links to technical publications and fact sheets on the use of coal combustion products in highways.

<http://www.epa.gov/epawaste/partnerships/c2p2/use/highway.htm>

Recycled Materials Resource Center

The Recycled Materials Resource Center (RMRC) is a national center that promotes the appropriate use of recycled materials in the highway environment. Their mission includes systematically testing, evaluating, developing appropriate guidelines for and demonstrating environmentally acceptable increased use of recycled materials in transportation infrastructure construction and maintenance. The RMRC website provides information on recycling and reusing industrial materials in roadways. It is funded by the Federal Highway Administration and the U.S. Environmental Protection Agency. <http://www.recycledmaterials.org/>

NEW!

AASHTO Center for Environmental Excellence Waste Management & Recycling Page

http://environment.transportation.org/environmental_issues/waste_manage_recyc/#bookmarkRecycling

NEW!

Using Recycled Industrial Materials in Roadways

U.S. EPA is developing a fact sheet that provides information on the use of industrial materials in roadways as an alternative to virgin materials and construction products. This fact sheet is not yet available.

Using Coal Ash in Highway Construction, EPA-530-K-05-002, April 2005

Provides information on both the environmental benefits and potential impacts of using coal combustion products in various highway construction applications. This booklet is sponsored by the U.S. Environmental Protection Agency, in cooperation with the Department of Energy, Federal Highway Administration, the American Coal Ash Association, and the Utility Solid Waste Activities Group.
<http://www.epa.gov/epawaste/partnerships/c2p2/pubs/greenbk508.pdf>

Office of Pavement Technology Recycling Homepage

One focus area for the Federal Highway Administration's (FHWA) Office of Pavement Technology is environmental stewardship which includes recycling and reducing noise abatement. Their recycling website includes information on FHWA's current projects and activities to facilitate the use of recycled materials in the highway environment.
www.fhwa.dot.gov/pavement/recycling/index.cfm

UPDATED!

User Guidelines for Industrial Byproduct Materials in Pavement Construction

The User Guidelines is an FHWA-developed information resource for 20 different byproduct materials in road construction. The Guidelines were recently updated to include current information about the U.S. EPA's Resource Conservation Challenge priority materials, coal ash, foundry sands and construction and demolition materials, along with current information about environmental considerations in the use of byproduct materials.
<http://www.recycledmaterials.org/tools/uguidelines/index.asp>

NEW!

Materials Recycling and Reuse – Finding Opportunities in Colorado Highways, CDOT-2007-12, October 2007

Analysis by CDOT to determine a strategy to improve recycling on Colorado highway projects. The project focused on 5 high volume materials: asphalt, concrete, metal, wood, and tires. This report was funded by a Resource Conservation Grant from U.S. EPA Region 8
<http://www.dot.state.co.us/Publications/PDFFiles/epagrant.pdf>

Report on Use of Recycled Foundry Sand in the Cleveland Area

Published Federal Highway Administration report providing a review on the uses of foundry sand in roadway construction around the Cleveland, Ohio area.
<http://www.fhwa.dot.gov/pavement/recycling/cleveland.cfm>

NEW!

Study on Increasing the Usage of Recovered Mineral Components in Federally Funded Projects Involving Procurement of Cement or Concrete, EPA 530-R-08-007, June 2008

<http://www.epa.gov/epawaste/conserve/tools/cpg/products/cement2.htm#report>

Fly Ash Facts for Highway Engineers, FHWA-IF-03-019, June 2003

Provides basic technical information on the various uses of fly ash in highway construction. This booklet is sponsored by the U.S. Department of Transportation's Federal Highway Administration, in cooperation with the American Coal Ash Association and the U.S. Environmental Protection Agency. www.fhwa.dot.gov/Pavement/recycling/fafacts.pdf

Federal Highway Administration (FHWA) Guidebook on Fly Ash

Provides information on specifications, mix design, and recommendations for the use of fly ash as a mineral admixture in the production of concrete. www.fhwa.dot.gov/infrastructure/materialsgrp/flyash.htm

Federal Highway Administration (FHWA) Guidebook on Ground Granulated Blast Furnace Slag

Provides information on specifications, mix design, and recommendations for the use of ground granulated blast furnace slag as a mineral admixture in the production of concrete. www.fhwa.dot.gov/infrastructure/materialsgrp/ggbfs.htm

Federal Highway Administration (FHWA) Guidebook on Silica Fume

Provides information on specifications, mix design, and recommendations for the use of silica fume as a mineral admixture in the production of concrete. www.fhwa.dot.gov/infrastructure/materialsgrp/silica.htm

Foundry Sand Facts for Civil Engineers, FHWA-IF-04-004, May 2004

Provides technical information on the potential uses of foundry sand in civil engineering applications. This booklet is sponsored by the U.S. Department of Transportation's Federal Highway Administration, in cooperation with the Foundry Industry Recycling Starts Today, and the U.S. Environmental Protection Agency. <http://isddc.dot.gov/OLPFiles/FHWA/011435.pdf>

Transportation Applications of Recycled Concrete Aggregate

Report by the Recycled Materials Resource Center (RMRC) which reviews the most advanced transportation uses of recycled concrete aggregate in the United States. It summarizes the review of recycled concrete aggregate practices in Texas, Virginia, Michigan, Minnesota, and California. This review was conducted by the Federal Highway Administration through the RMRC. <http://www.fhwa.dot.gov/Pavement/recycling/rca.cfm>

Recycled Materials in European Highway Environments: Uses, Technologies, and Policies

Federal Highway Administration sponsored document that reports on innovative policies, programs, and techniques that promote the use of recycled materials in the highway environment. <http://international.fhwa.dot.gov/pdfs/recycolor.pdf>

Cold-In Place Recycling Review

Technical review conducted by the Federal Highway Administration to identify

best practices and the most advanced uses of Cold-In-Place recycling.

www.fhwa.dot.gov/pavement/recycling/cir/execsum.cfm

Cold In-Place Recycling: Performance-Based Design

The University of New Hampshire, in conjunction with the University of Rhode Island, conducted research to develop a performance-based mix design for cold-in place recycling for use by State Highway Administrations and local governments. The research was funded by the FHWA.

<http://isddc.dot.gov/OLPFiles/FHWA/010964.pdf>

Pavement Recycling Guidelines for State and Local Governments, FHWA-SA-98-042, December 1997

This reference document includes information on recycling asphalt pavements: performance data, legislation/specification limits, selection of pavement for recycling and recycling strategies, economics of recycling, and the structural design of recycled pavements. This reference document funded by the Federal Highway Administration was developed to support the following workshop "Pavement Recycling Guidelines for State and Local Governments" which was held in twelve locations throughout the United States.

<http://www.fhwa.dot.gov/pavement/recycling/98042/>

Pavement Recycling Executive Summary and Report

A report published by the Federal Highway Administration documents a study conducted between 1992 and 1996 to assess the state-of-the-practice of recycled hot mix construction. <http://isddc.dot.gov/OLPFiles/FHWA/011182.pdf>

Federal Highway Administration Policy and Technical Advisories

Federal Highway Administration (FHWA) Recycled Materials Policy

FHWA's policy statement is designed to advance the use of recycled materials in highway applications. The policy outlines the importance of re-using materials previously used in constructing the Nation's highway system, and calls upon the FHWA and State transportation departments to explicitly consider recycling as early as possible in the development of every project.

www.fhwa.dot.gov/legsregs/directives/policy/recmatmemo.htm

Technical Advisory T 5080.9. Use of Coal Ash in Embankments and Bases. U.S. Department of Transportation, Federal Highway Administration, May 1988. This Technical Advisory provides guidance and recommendations relating to the use of coal ash in bases and embankments. It covers the history of coal ash use in these applications along with discussions on environmental, design, and construction considerations.

www.fhwa.dot.gov/legsregs/directives/techadvs/t508009.htm

Technical Advisory: Use of Recycled Concrete Pavement as Aggregate in Hydraulic-Cement Concrete Pavement

This Technical Advisory issues information on state-of-the-practice and guidance for the use of recycled concrete pavement as aggregate in concrete used for pavements. www.fhwa.dot.gov/legregs/directives/techadvs/t504037.htm

Standard/Specifications

American Association of State Highway and Transportation Officials (AASHTO) Subcommittee on Materials

The AASHTO Subcommittee on Materials focuses on developing specifications for materials used in the construction and maintenance of all transportation facilities including highways, bridges and structures, and standard methods of sampling and testing these materials; and serves as a conduit to exchange information on the performance of special products evaluated by AASHTO Member Departments. The Subcommittee on Materials also maintains and updates the *Standard Specifications for Transportation and Methods of Sampling and Testing, and Provisional Standards* Materials reference which contains 418 materials specifications and test methods commonly used in the construction of highway facilities.

<http://materials.transportation.org/default.aspx>

Recycled Materials Resource Center (RMRC) Project 13/14: The Development and Preparation of Specifications for Using Recycled Materials in Highway Applications

RMRC's project 13/14 focused on the development of specifications for recycled materials in highway construction. The RMRC is funded by the Federal Highway Administration and the U.S. Environmental Protection Agency.

<http://www.recycledmaterials.org/Research/past/P13&14/p1314summary.pdf>

National Standards/Specifications

The Recycled Materials Resource Center has consolidated a listing of standards and specifications for use of industrial materials in roadways. Visit

<http://www.recycledmaterials.org/tools/uguidelines/standards.asp> for standards/specifications on:

- Coal Fly Ash
- Coal Bottom Ash/Boiler Slag
- Foundry Sand
- FGD Scrubber Material
- Roofing Shingles
- Reclaimed Asphalt
- Reclaimed Concrete
-

FHWA National Highway Specifications Website

Developed and maintained by the Federal Highway Administration, this website consists of a searchable library of highway specifications from across the nation.

<http://fhwapap04.fhwa.dot.gov/nhswp/index.jsp>

State Specifications/Provisions on Recycling Technology

State Transportation Websites

Links to state transportation websites from the Federal Highway Administration website www.fhwa.dot.gov/webstate.htm

NEW!

State DOT Search Engine -- Google

Search the websites of the Departments of Transportation from the fifty United States and the District of Columbia

<http://www.google.com/coop/cse?cx=006511338351663161139%3Acnk1qdck0dc>

Engineering and Environmental Specifications of State Agencies for Utilization and Disposal of Coal Combustion Products: Volume 1 – DOT Specifications 2005-EERC-07-04

The Energy & Environmental Research Center at the University of North Dakota conducted a state by state comparison of U.S. Department of Transportation specifications for using coal combustion products.

www.undeerc.org/carrc/Assets/Vol1DOT.pdf

University of Wisconsin's Beneficial Use Information Center (BUIC)

The BUIC is a virtual center created by the Geotechnical/Geoenvironmental Group at the Department of Civil and Environmental Engineering at the University of Wisconsin-Madison to provide a location where designers and users can access information, including specifications, relevant to the beneficial reuse of foundry byproducts.

Flowable Fill Specifications for Foundry Sand Use in Select States

<http://geoserver.cee.wisc.edu/buic/specific.htm>

Specification for Foundry Sand Used as Fill Material

<http://geoserver.cee.wisc.edu/buic/newpage3.htm>

Specifications for Foundry Sand Used in Portland Cement Concrete

<http://geoserver.cee.wisc.edu/buic/specific1.htm>

Specifications for Foundry Sand Used in Asphalt Concrete

<http://geoserver.cee.wisc.edu/buic/specific2.htm>

Specifications for Foundry Sand Used in Portland Cement Manufacturing

<http://geoserver.cee.wisc.edu/buic/specific3.htm>

Specifications for Foundry Sand Used in Growing Mix

<http://geoserver.cee.wisc.edu/buic/specific4.htm>

Specifications for Foundry Sand Used as Landfill Liners and Covers

<http://geoserver.cee.wisc.edu/buic/specific5.htm>

Indiana Department of Transportation (InDOT) Standard Specifications

Pages 693-696 covers fly ash and ground granulated blast furnace slag used as a pozzolan; and pages 697-699 addresses silica fume used as a pozzolanic mineral admixture. www.in.gov/dot/div/contracts/standards/book/sep07/2008Master.pdf

InDOT Special Provision 203-R-360. Embankments Constructed of Coal Combustion By-Products

www.in.gov/dot/div/contracts/standards/rsp/mar05/203R360.pdf

InDOT Special Provision 211-R-415. Crushed Glass as Bedding Material

www.in.gov/dot/div/contracts/standards/rsp/sep07/200/211-R-415%20070901.pdf

InDOT Special Provision 200-R-401. Recycled Foundry Sand

www.in.gov/dot/div/contracts/standards/rsp/sep07/200/200-R-401%20070901.pdf

Illinois DOT Specifications – Materials

www.dot.state.il.us/desenv/pdfs/spec2002/sec1000.pdf

Caltrans Standard Specifications May 2006

Pages 229-236 address reclaimed base/subbase; pages 329-33 cover fly ash for grout; and pages 751-752 cover the recycled materials for Portland Cement concrete.

www.dot.ca.gov/hq/esc/oe/specifications/std_specs/2006_StdSpecs/2006_StdSpecs.pdf

NEW!

Oregon Bridge Delivery Program - Department of Transportation

Provides information on recycling including a directory which focuses primarily on materials that may be generated during demolition/construction activities of a bridge or roads (metals, concrete, wood, asphalt, etc.)

<http://www.obdp.org/partner/environmental/>

Texas Department of Transportation

Specifications for Recycled Materials

http://www.txdot.gov/business/contractors_consultants/recycling/speclist.htm

Recycled Concrete Aggregates Make Cents, September 2008

ftp://ftp.dot.state.tx.us/pub/txdot-info/cmd/tech/rca_barton.pdf

Wisconsin DOT Roadway Standards Manuals

<http://roadwaystandards.dot.wi.gov/standards/>

Resources for Assessing Risk in Roadway Environments

Evaluation of the Industrial Waste Evaluation Model (IWEM) For Non-Federal Users With Regard to Highway Applications

Funded by the U.S. EPA, the Recycled Materials Resource Center conducted

work to evaluate whether IWEM can be used as a predictive tool to accurately determine whether leaching from materials will result in significant changes in groundwater concentrations when the materials are reused as a base or sub-base in a roadway. <http://www.epa.gov/epawaste/partnerships/c2p2/pubs/iwem.pdf>

Geo Engineering Report No. 05-22: Assessing Groundwater Impacts from Coal Combustion Products Used In Highways

The Department of Civil and Environmental Engineering at the University of Wisconsin-Madison evaluated a computer application, called WiseLeach, that was developed to assess impacts to groundwater caused by leaching of trace elements from coal combustion products used in highway construction. This study was funded by the Wisconsin Department of Natural Resources Waste Reduction and Recycling Demonstration grant Program and Alliant Energy.

<http://www.epa.gov/epawaste/partnerships/c2p2/pubs/impacts.pdf>

Geo Engineering Report No. 05-21: Metals Leaching from Highway Test Sections Constructed with Industrial Byproducts

Describes the results of a study by the Department of Civil and Environmental Engineering at the University of Wisconsin-Madison to assess metals leaching from industrial byproducts (foundry sand and foundry slag from a gray-iron foundry; and bottom ash and fly ash from a coal-fired power plant) used in highway construction. This study was funded by the Recycled Materials Research Center through the Wisconsin Department of Transportation, the Wisconsin Department of Natural resources Waste reduction and recycling Demonstration Grant Program, and Alliant Energy.

<http://www.epa.gov/epawaste/partnerships/c2p2/pubs/metals.pdf>

Case Studies –Roadways and Other Infrastructure

EPA's Coal Combustion Products Partnership (C²P²) Program Case Studies

Visit <http://www.epa.gov/epawaste/partnerships/c2p2/cases/index.htm> for a comprehensive listing of case studies exhibiting the use of coal combustion products. Featured roadway case studies include:

Fly Ash Sub-Grade Stabilization and PPC Optimization, Washburn Municipal Airport

Presents the use of fly ash as a sub-grade stabilization layer in the construction of a paved runway.

<http://www.epa.gov/epawaste/partnerships/c2p2/cases/02-airport.pdf>

Fly Ash Concrete Design for Chicago's 100-Year Road Structure

Presents the performance benefits of using fly ash in a concrete roadway to increase the roadway's service life.

<http://www.epa.gov/epawaste/partnerships/c2p2/cases/03-wacker.pdf>

Fly Ash for Highway Construction and Site Development

Presents six state demonstration projects on the use of fly ash in various

aspects of roadway construction.

<http://www.epa.gov/epawaste/partnerships/c2p2/cases/10-highway2.pdf>

Full Depth Reclamation - A Rehabilitation Option for Deteriorated Hot Mix Asphalt Pavements

Presents the use of Class F fly ash, as an additive, to enhance the strength of an existing pavement for recycling.

<http://www.epa.gov/epawaste/partnerships/c2p2/cases/15-fdr.pdf>

Fly Ash in California's Olivenhain Dam

Presents the use of fly ash to construct the Olivenhain Dam.

<http://www.epa.gov/epawaste/partnerships/c2p2/cases/04-dam.pdf>

NEW!

High-Volume Use of High-Carbon Fly Ash for Highway Construction

<http://www.epa.gov/epawaste/partnerships/c2p2/cases/21-highcrbnash.pdf>

Coal Fly Ash Used on Ohio Full Depth Reclamation Projects

Article published by Asphalt Contractor on the effective use of Class F fly ash in combination with lime or lime kiln dust in the full depth reclamation of roadways. Asphalt Contractor is an on-line magazine dedicated to asphalt producers and contractors. The magazine provides hot mix asphalt material producers, highway contractors and public works officials with critical "how-to" information on the process of HMA production, paving, and compaction.

<http://www.forconstructionpros.com/print/Asphalt-Contractor/Features/Rehabilitating-Asphalt-Highways/2FCP4421>

Indiana Department of Transportation (InDOT) Case Studies

Case Studies #1-6

<http://www.epa.gov/epawaste/conservation/rrr/imr/pdfs/indian1.pdf>

#1: Use of Bottom Ash in an Embankment

#2: Use of a Mixture of Bottom Ash and Fly Ash in an Embankment

#3: Use of a Mixture of Fly Ash and Bottom Ash in an Embankment

#4: Use of Foundry Sand in an Embankment

#5: Use of Shredded Tires in an Embankment

#6: Use of Crushed Glass as Backfill

Use of Fly Ash in Embankments

<http://www.epa.gov/epawaste/conservation/rrr/imr/pdfs/indiana2.pdf>

InDOT BU Case Study Documentation

<http://www.epa.gov/epawaste/conservation/rrr/imr/pdfs/indiana3.pdf>

Wisconsin Department of Transportation (WisDOT) Case Studies

WisDOT Case Studies #1-2

<http://www.epa.gov/epawaste/conservation/rrr/imr/pdfs/wiscon1.pdf>

#1: Use of Fly Ash in an Embankment

#2: Use of Fly Ash to Stabilize Soils

Presentation on WisDOT Fly Ash Stabilization Experiences

<http://www.epa.gov/epawaste/conservation/rrr/imr/pdfs/wiscon2.pdf>

Foundry Industry Starts Recycling Today (FIRST) Roadway Case Studies

The FIRST website provides several case studies on the beneficial use applications for spent foundry sand under the “Technical Applications” tab. The initial case studies were developed for FIRST under a grant from U.S. EPA Region 5. Registered users of the foundryrecycling.org website can download these case studies. Registration is free.

www.foundryrecycling.org/TechnicalApplications/CaseStudies/tabid/315/Default.aspx

Foundry Sand as an Asphalt Pavement Ingredient

A case study on the use of foundry sand in asphalt pavement for a high performance test track.

Foundry Sand as Structural Fill and Road Base

A case study on the use of aluminum foundry sand for local construction projects.

Foundry Sand as Sub Base for an Airport Runway

A case study using foundry green sand as a subbase for a commercial airport runway.

Foundry Sand for Roadbase and Manufactured Soil

A case study on reclamation of a Pennsylvania coal mine using foundry sand.

A Resource Recovery Cooperative

A case study of a foundry-owned cooperative in Michigan that processes sand from multiple foundries for use in asphalt paving, landfill liners, and soils.

National Slag Association (NSA) Roadway-Related Case Studies

The NSA website provides several cases studies on the beneficial use applications for slag under the “Research/Library” tab.

Sudden Stops and Starts Don’t Bother the Illinois Tollway Plazas Anymore

www.nationalslag.org/archive/nsa_200-4_eaf_slag_sand_mix-iltollway.pdf

Largest Stone Matrix Asphalt Project in USA Spans 6 lanes for 8 Miles

http://www.nationalslag.org/archive/nsa_200-9_largest_sma_project_in_us.pdf

NASCAR Drivers Know a Smooth Surface Starts with a Strong Foundation

www.nationalslag.org/archive/nsa_202-4_chicagoland_raceway.pdf

Slag Fills Six Miles of Two New Concrete Lanes on Busy I-65 in Hobart, Indiana

http://www.nationalslag.org/archive/nsa_202-5_six_lanes_of_bf_concrete_on_i-65.pdf

Once Again Slag Proves “Less is More” on Michigan’s M-63 in Benton Harbor

www.nationalslag.org/archive/nsa_202-6_michigan_m-63_bf_embankment.pdf

I-70 through Colorado’s Glenwood Canyon

www.nationalslag.org/archive/nsa_202-7_glenwood_canyon_slag_paving_on_i-70.pdf

Lightweight Slag – the Product of Choice for Highway 17 in Renfrew, Ontario

www.nationalslag.org/archive/nsa_204-1_lightweight_fill-expanded_slag.pdf

Air Cooled Blast Furnace Slag is Major Component of NCAT Test Track Research

www.nationalslag.org/archive/nsa_204-2_ncat_test_track-bf_slag.pdf

“Whitetopping” Thin Concrete Overlays Use Blast Furnace Slag in Wayne County, Michigan

www.nationalslag.org/archive/nsa_205-1_bf_slag_whitetopping.pdf

Department of Defense Paving Materials Highlight Environmental Attributes

An Environmentally Preferable Purchasing Case Study successfully used recycled content products, such as asphalt and concrete.

www.epa.gov/epp/pubs/case/dod_pave.htm

Kukkia Circlet Environmentally Friendly System to Renovate Secondary Roads

A research and demonstration project in Finland on the use of boiler ash and wastewater residual solids from pulp and paper mills in improving unpaved roads.

http://projektit.ramboll.fi/luopioinen/life/pdf/julkaisut/Paper_ISEG_corr.pdf

Mid-Atlantic Green Highways Partnership

Green Highways Partnership- Recycling and Reuse of Industrial Materials Team

The Recycling and Reuse Theme Team's section of the Green Highways Partnership website provides information on using recycled materials in roadway construction and recycling opportunities for highway rest stops.

www.greenhighways.org/reuse_Recycling.cfm

C. RECYCLING AND REUSING INDUSTRIAL MATERIALS IN AGRICULTURAL & HORTICULTURAL APPLICATIONS

U.S. Department of Agriculture (USDA) Agricultural Research Service (ARS)

ARS conducts research to develop and transfer solutions to agricultural problems of high national priority and provide information access and dissemination. The ARS research is organized into National Programs categorized by four areas. The Natural Resources and Sustainable Agricultural Systems National Programs develops technologies and strategies needed to help farmers, ranchers, and other managers effectively steward the diverse agricultural mosaic spread across the nation. The Manure and Byproduct Utilization National Program under the Natural Resources area develops cost-effective management practices, technologies and decision aids that will allow producers to capture the value of manure and other byproducts without degrading environmental quality or posing a threat to human and animal health.

ARS Homepage

www.ars.usda.gov/main/main.htm

Manure and Byproduct Utilization Website

http://www.ars.usda.gov/research/programs/programs.htm?NP_CODE=206

ARS projects focused on byproduct utilization include:

A Practical Study on Foundry Sand: Literature Review, Inventory, Blending Guidelines, and Interaction with Nursery Industry Representatives

http://www.ars.usda.gov/research/projects/projects.htm?accn_no=407643

Use of Spent Foundry Sand: Assessment of Transport and Availability of Trace Metal and Organic Contaminants and Nutrient Dynamics in Topsoil

http://www.ars.usda.gov/research/projects/projects.htm?accn_no=407698

Liaison, Coordination, and Data Transfer Between Foundry Sand Industry and the Agricultural Research Service

http://www.ars.usda.gov/research/projects/projects.htm?accn_no=407712

Mineral Characteristics of Foundry Sand: Impacts on Soil Hydraulic Conductivity, Erosion and Plant Growth

http://www.ars.usda.gov/research/projects/projects.htm?accn_no=409235

Risk Assessment and Remediation of Soil and Amendment Trace Elements

http://www.ars.usda.gov/research/projects/projects.htm?accn_no=409625

Agricultural and Industrial Uses of FGD Gypsum

http://www.ars.usda.gov/research/projects/projects.htm?ACCN_NO=412739

National Council for Air and Stream Improvement Inc. (NCASI)

NCASI is an independent, non-profit research institute that focuses on environmental topics of interest to the forest products industry and has published several technical bulletins on using paper mill byproducts as soil amendments.

www.ncasi.org/publications/default.aspx

NEW!

Agricultural Uses for Flue Gas Desulfurization (FGD) Gypsum Brochure, EPA530-F-08-009, March 2008

Provides general and technical information on the use of FGD gypsum in agricultural applications. <http://www.epa.gov/epawaste/partnerships/c2p2/pubs/fgd-fs.pdf>

Alternative Agricultural Liming Materials

The Alternative Agricultural Liming Materials provides information on specific types of industrial materials that can be used as liming agents. This was developed as part of a broader internet training course on Soil Acidity and Liming by the Clemson University Extension Service under the Department of Entomology, Soils, and Plant Sciences.

<http://hubcap.clemson.edu/~blpprt/acid5.html>

Using Industrial Wood Ash as a Soil Amendment

A publication providing technical, environmental, and economic information on the use of ash from woodburning industries as an agricultural amendment. This publication was made possible by a grant from the Sustainable Agriculture Program, Agricultural Resource Management Division, Wisconsin Department of Agriculture, Trade, and Consumer Protection with funding from the Wisconsin Energy Bureau, Department of Administration. <http://learningstore.uwex.edu/pdf/A3635.pdf>

Wood Ash – An Alternative Liming Material for Agricultural Soils

A publication, developed by Alberta Canada's Ministry of Agriculture and Food, providing information on the technical use and benefits of using wood ash from pulp and saw mills as an agricultural soil amendment.

[http://www1.agric.gov.ab.ca/\\$Department/deptdocs.nsf/all/agdex3435](http://www1.agric.gov.ab.ca/$Department/deptdocs.nsf/all/agdex3435)

Recommended Practices for Using Wood Ash as an Agricultural Soil Amendment. Bulletin 1147, September 2002

A publication, developed by the University of Georgia, College of Agricultural and Environmental Sciences, that discusses a method for applying wood ash as a lime substitute on agricultural lands. This method can be used by manufacturers and dealers

who wish to supply wood ash or by landowners who wish to receive wood ash.

<http://pubs.caes.uga.edu/caespubs/pubcd/B1147.htm>

Using Recycled Wallboard for Crop Production

A publication providing general and technical information on the potential uses for applying recycled gypsum wallboard to crops and at a construction site. This publication was funded by WasteCap Wisconsin, Inc. from a grant through the U.S. Environmental Protection Agency. <http://learningstore.uwex.edu/pdf/A3782.pdf>

Demonstration of Coal Ash for Feedlot Surfaces

The University of North Dakota's Energy & Environmental Research Center has demonstrated the placement, engineering and environmental performance, and economics of using coal ash to stabilize feedlots. The technical report and other information sources on coal ash use in feedlot stabilization are found on the website. The funding for this demonstration was provided by Great River Energy, Otter Tail Power Company, the U.S. Department of Energy National Energy Technology Laboratory, the North Dakota Industrial Commission, and the North Dakota State Board of Agricultural Research and Education. www.undeerc.org/carrc/html/Feedlot.html

Soil Remediation, Revitalization, and Reuse: Technical Performance Measures

Developed by U.S. EPA's Superfund program, the Technical Performance Measures (TPM) is a web-based tool designed for site managers, their technical support teams, and other stakeholders to assess whether soil amendments used for remediation, revitalization, and reuse of metals-contaminated sites are functioning as designed to reduce risks to human health and the environment. The TPMs could be applied to the beneficial use of materials as soil amendments. www.clu-in.org/products/tpm/

Case Studies – Agricultural and Horticultural Uses

Foundry Industry Starts Recycling Today (FIRST) Agricultural Case Studies

The FIRST website provides several case studies on the beneficial use applications for spent foundry sand under the "Technical Applications" tab. The initial case studies were developed for FIRST under a grant from U.S. EPA Region 5. Registered users of the foundryrecycling.org website can download these case studies. Registration is free. www.foundryrecycling.org/TechnicalApplications/CaseStudies/tabid/315/Default.aspx

Foundry Sand for Manufactured Soil and Roadbase

A case study on reclamation of a Pennsylvania coal mine using foundry sand.

Resource Recovery Cooperative

A case study of a foundry-owned cooperative in Michigan that processes sand from multiple foundries for use in soils, asphalt paving, and landfill liners.

National Slag Association (NSA) Agricultural-Related Case Studies

The NSA website provides several cases studies on the beneficial use applications for slag under the "Research/Library" tab.

American Agriculture Gets Growth Spurt Using Electric Arc Furnace Slag as Liming Agent

www.nationalslag.org/archive/nsa_201-4_eaf_slag_liming_agent.pdf

D. OTHER SPECIFICATIONS AND STANDARDS RESOURCES

Beneficial Use of Industrial By-Products: Identification and Review of Materials Specifications, Performance Standards, and Technical Guidance, December 2003

This document was developed for the National Council for Air and Stream Improvement under a grant from U.S. EPA Region 5. The document identifies and summarizes existing performance standards, material specifications, and technical guidance for the beneficial use of byproducts from four industries: cement, foundry, pulp and paper, and coal-fired utility. www.byproductsummit.com/midwest/summit/rmt_rpt.pdf

VI. FINDING INDUSTRIAL MATERIAL SUPPLIERS

Buyer's Guide to Coal Ash Containing Products

Developed by the University of North Dakota's Energy and Environmental Research Center, the Buyer's Guide provides information on available building materials containing coal ash as a raw material and links to suppliers. www.undeerc.org/carrc/BuyersGuide/default.asp

Headwaters Resources

Headwaters is a company that markets and supplies coal combustion products, such as fly ash. It operates distribution terminals on the east and west coasts. www.flyash.com/

National Slag Association (NSA)

The NSA has a listing of iron and steel slag processors in the U.S. based on a U.S. Geological Survey report. www.nationalslag.org/slagsites.htm

U.S. EPA Comprehensive Procurement Guidelines (CPG) Supplier Database

The CPG Supplier database is tool to assist in locating vendors who sell or distribute CPG-designated products with recycled content. CPG-designated products are those products identified by the EPA that are or can be made with recovered materials. For products designated by EPA, procuring agencies using federal funds are required to buy the product with the greatest recycled content practicable. <http://www.epa.gov/epawaste/conservetools/cpg/database.htm>

General Service Administration (GSA) Advantage

Cement and concrete containing coal fly ash can be ordered through the General Service Administration's (GSA's) online ordering system. In addition, GSA publishes various supply catalogues, guides, and schedules for recycled-content products available through the Federal Supply Service. https://www.gsaadvantage.gov/advgsa/advantage/main/start_page.do

Environmentally Preferable Purchasing (EPP) Database

The environmentally preferable purchasing database, developed by public and private organizations, is a tool to assist in the purchasing of products and services with reduced environmental impacts. This database contains environmental information on over 600 products

including contract language, specifications, and policies; environmental standards and guidelines; and lists of vendors that meet these standards.

<http://yosemite1.epa.gov/oppt/epstand2.nsf>

Northeast Recycling Council's Environmentally Preferable Products Listserv (EPPnet)

EPPnet is a listserv for federal, state, and local environmental procurement officials; and private procurement specialists charged with purchasing green products and services and developing policies for the procurement of these products. EPPnet provides subscribers with information which includes availability of product specifications, vendors of particular products, and pricing information. www.nerc.org/eppnet/index.html

Rubbersidewalks, Inc.

Rubbersidewalks, Inc. is a company that markets, sells, and supplies modular sidewalk paving systems, and other products made from recycled tire rubber. <http://www.rubbersidewalks.com>

VII. LOCATING C&D MATERIALS RECYCLERS

Construction Materials Recycling Association Website

The Construction Materials Recycling Association's (CMRA) website, under the "Find a Recycler" section, provides a list of C&D recyclers. CMRA is a 501(c)(3) organization that promotes the recycling of construction and demolition materials.

www.cdrecycling.org/

Construction Industry Compliance Assistance Center (CICA)

The CICA center is an EPA-funded environmental compliance assistance website for contractors and builders/developers. The website contains a C&D materials State Resource Locator, where contractors can find state and municipal recycling programs.

www.cicacenter.org

The Whole Building Design Guide's Construction Waste Management Database

The Construction Waste Management Database contains information on companies that haul, collect, and process recyclable debris from construction projects. Created in 2002 by the U.S. General Services Administration's Environmental Strategies and Safety Division to promote responsible waste disposal, the database is a free online service for those seeking companies that recycled construction debris in their area. The database is searchable by state, zip code, or materials recycled.

www.wbdg.org/tools/cwm.php

VIII. LOCATING POTENTIAL END-USERS

American Foundry Society's (AFS) Beneficial Reuse Directory

This tool provides users the ability to search by zip code and radius to identify ready-mixed concrete, asphalt, and Portland cement facilities that may use spent aluminum, iron, and steel foundry sands in their manufactured products. The end-users are available through a listing and Google map views. www.afsinc.org/component/option,com_mtree/Itemid,193

IX. INDUSTRIAL MATERIALS RECYCLING IN THE NEWS

NEW!

EPA and Montclair State University Agree on High Environmental Goals

EPA press release highlighting Montclair State University's commitment, through a Memorandum of Understanding with the U.S. EPA Region 2, to utilize some of the latest green technologies and practices at its 246-acre campus.

<http://yosemite.epa.gov/opa/admpress.nsf/a883dc3da7094f97852572a00065d7d8/b6c139f789ca1f7d8525746b00554201!OpenDocument>

NEW!

EPA and New York Mets Agree on Environmental Goals for Citi Field

EPA press release highlighting Queens Ballpark Company, L.L.C commitment to build and operate Citi Field, the New York Mets' new stadium, using some of the latest green technologies and practices.

<http://yosemite.epa.gov/opa/admpress.nsf/0/D87469E9E29DE0238525740B004FC02C>

NEW!

Professionals and Students Recognized for Lifecycle Building Innovation

EPA press release highlighting the second annual Lifecycle Building Challenge awards ceremony at the WasteWise/National Partnership for Environmental Priorities Conference in Washington, D.C..

<http://yosemite.epa.gov/opa/admpress.nsf/0/D6E7D07F607FDBEE852574F100789DA1>

NEW!

Byproducts Becoming Cornerstones

New York Times article published in the Square Feet pages on November 2008 about the growing proportion of recycled material in the concrete for office and residential towers.

http://www.nytimes.com/2008/11/19/business/19concrete.html?_r=1&sq=byproducts%20becoming%20corner%20stones&st=cse&adxnnl=1&scp=1&adxnnlx=1230662940-tpyo8H6MCWx1w5230YNm8w

NEW!

Reduce, reuse, recycle

American City and County magazine article published on October 2008 about the green practices encouraged throughout Washington state, but especially in King County including the use of fly ash as a cement substitute.

http://americancityandcounty.com/pubwks/solid_waste/reduce_reuse_recycle/

America Recycles Day Presidential Proclamation

Statement by the President recognizing the importance of safe recycling from electronics to industrial byproducts.

www.whitehouse.gov/news/releases/2006/11/20061115.html

Structure to be World's Largest Built with Recycled Industrial Materials

EPA press release announcing Destiny USA's promise to build with recycled industrial materials and to use a variety of other environmentally sustainable practices in its Syracuse, N.Y. project.

<http://yosemite.epa.gov/opa/admpress.nsf/a8f952395381d3968525701c005e65b5/73e240963aa2aad0852571f50057e48c!OpenDocument>

EPA and DestiNY USA Announce Memorandum of Understanding (MOU)

EPA press release highlighting the signing of an agreement, by EPA Region 2 Administrator

Alan J. Steinberg and Destiny USA founder and chairman Robert Congel, committing Destiny USA to use environmentally-sound practices in constructing and running its project in Syracuse, N.Y.

<http://yosemite.epa.gov/opa/admpress.nsf/a8f952395381d3968525701c005e65b5/51dbfdcc14dce9db852571f40059eb9a!OpenDocument>

Kohler Aims for Cleaner Bodies and a Cleaner Environment – Foundry Sand

EPA news article on Kohler's successful endeavors in working with the Wisconsin DOT and other companies to recycle their non-hazardous spent foundry sand as a sub-base for roads and other construction applications.

<http://epa.gov/epawaste/inforesources/news/2007news/07-kohler.htm>

Statement by Gov. Schwarzenegger on EPA Award for California's Leadership in the Construction Use of Waste Products

<http://gov.ca.gov/index.php?/press-release/4839/>

Fly Ash Reuse Takes Off

EPA news article on the reuse of fly ash in the construction of the new runway at Wisconsin's Waukesha County Airport.

<http://epa.gov/epawaste/inforesources/news/2007news/02-fly-ash.htm>

U.S. EPA Announces Winners of First in the Nation Lifecycle Building Design Competition

EPA press release highlighting the awards ceremony of the inaugural Lifecycle Building Challenge on September 20, 2007, at the West Coast Green Conference in San Francisco. This is a national competition to promote building material reuse through disassembly and adaptability and has collected innovative design ideas from across the nation.

<http://yosemite.epa.gov/opa/admpress.nsf/2dd7f669225439b78525735900400c31/2b56503f821d50168525735c0079d5e4!OpenDocument>